

[0221] Upon joining a NAN cluster, a NAN device synchronizes itself both to the sync frame transmission and discovery window schedule of the cluster.

[0222] Additionally, the device is responsible for running the master election algorithm to determine whether it is a master device that is responsible for transmitting a sync frame.

[0223] Operating in a NAN Cluster

[0224] A NAN device may continue operating in a NAN cluster as long as one of the following criteria is met:

[0225] The device receives at least one sync frame from the cluster with signal level exceeding a pre-determined threshold RSSI_C (e.g. -50 dBm).

[0226] The device operates as a master device transmitting sync frames.

[0227] When operating in a NAN cluster, a NAN device is responsible for maintaining both the base clock of the cluster by transmitting sync frames as needed, and the discovery window schedule of the cluster.

[0228] Master Election

[0229] In accordance with an example embodiment of the invention, a node, device, or STA may operate in one of two roles: As a Master Sync STA, it competes with other Master STAs to transmit a Beacon. As a Non-Master Sync STA, it does not compete to transmit a Beacon. The Master Sync STA role may be determined by the Master Election Algorithm for Neighbor Awareness Networking. Every node, device, or STA of an ad hoc network may need to be able to operate in both roles and the Master Election Algorithm may need to be run by every node, device, or STA once in a while or periodically.

[0230] A NAN device that operates in a NAN cluster may need to be responsible for determining for each discovery window, as per the master election algorithm, whether it is a master device.

[0231] A Sync Frame from a Foreign Cluster

[0232] When a NAN device detects a sync frame of a NAN cluster different from the one in which the device operates, but both the clusters belong to the NAN network the device operates in, and the sync frame is received with signal level exceeding a pre-determined threshold RSSI_C (e.g. -50 dBm), the device proceeds as follows:

[0233] If the timestamp (e.g. TSF value) in the sync frame from the foreign cluster is larger than the time in one's own cluster, the device moves its operations to the foreign cluster.

[0234] Alternatively some other information in the sync frame from the foreign cluster is analyzed to determine whether the device moves its operations to the foreign cluster.

[0235] Otherwise the device continues its operations in the current cluster.

[0236] Moving Operations to a New Cluster

[0237] When a NAN device operates in a network of synchronized clusters, it shall do as follows when moving its operations to a new cluster upon detecting the existence of the new cluster through passive discovery:

[0238] a) If the device is a master device in the current/old cluster, the rules are as follows:

[0239] The device transmits as a master device in the current/old cluster at least one sync frame that contains information about the new cluster. This includes information at least about TSF value and discovery window schedule of the new cluster.

[0240] Once the device has transmitted at least one sync frame in the current/old cluster with information about the new cluster, it shall start operating in the new cluster and ceases all the operations in the old cluster.

[0241] b) If the device is a non-master device in the current/old cluster, the rules are as follows:

[0242] The device shall start operating in the new cluster and ceases all the operations in the old cluster.

[0243] When a NAN device operates in a network of isolated clusters, it shall do as follows when moving its operations to a new cluster:

[0244] a) Regardless of whether the device is a master or a non-master device in the current/old cluster, the device shall start operating in the new cluster and ceases all the operations in the old cluster.

[0245] Aligning Discovery Window Schedules

[0246] When a NAN device operates in a network of synchronized clusters, it shall do as follows upon detecting the existence of the new cluster from a received sync frame that contains information about the new cluster and the new cluster is indicated to be the one whose discovery window is to be used:

[0247] a) If the device is a master device in the current/old cluster, the rules are as follows:

[0248] The device may transmit as a master device in the current/old cluster at least one sync frame that contains information about the new cluster.

[0249] The device starts using the discovery window schedule of the new cluster.

[0250] The device may activate passive discovery to find out whether it can detect the new cluster and whether it can receive sync frames from the new cluster with high enough signal level in order to synchronize from perspective of sync frame transmissions.

[0251] b) If the device is a non-master device in the current/old cluster, the rules are as follows:

[0252] The device starts using the discovery window schedule of the new cluster.

[0253] The device may activate passive discovery to find out whether it can detect the new cluster and whether it can receive sync frames from the new cluster with high enough signal level in order to synchronize from perspective of sync frame transmissions.

[0254] D. Hop Count Usage in NAN Cluster Selection

[0255] FIG. 1 illustrates an example network diagram of two neighbor awareness network (NAN) clusters 100A and 100B and a wireless device 110 in discovery mode. A set of NAN devices that operate in a NAN network with one NAN ID and that are synchronized with respect to both the sync frame transmissions and the discovery windows, form a NAN cluster. A NAN device in a NAN cluster will be either an anchor master device, a master device, a sync device, or a non-sync device. An anchor master, such as anchor master A in NAN cluster 100A, is the NAN device that has the highest master rank in the NAN cluster. A NAN master device, such as master device M2(A) in cluster 100A, sends discovery and synchronization beacons. A NAN sync device, such as sync device S5(A) in cluster 100A, sends synchronization beacons. A NAN device in the non-sync state, such as non-sync device N6(A) in cluster 100A, does not send beacons. Each NAN cluster 100A and 100B